PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21H 13/00 — A1

(11) International Publication Number: **WO 99/23306**

(43) International Publication Date: 14 May 1999 (14.05.99)

(21) International Application Number: PCT/US98/22967

(22) International Filing Date: 29 October 1998 (29.10.98)

(30) Priority Data:
60/064,142 31 October 1997 (31.10.97) US

(71) Applicant *(for all designated States except US)*: DEXTER CORPORATION [US/US]; One Elm Street, Windsor Locks, CT 06096 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: BYALIK, Ludmila [US/US]; 73 Northbrook Drive, West Hartford, CT 06117 (US). VIAZMENSKY, Helen [US/US]; 84 Thompson Road, Avon, CT 06001 (US).

(74) Agents: ALIX, James, E. et al.; Alix, Yale & Ristas, LLP, 750 Main Street, Hartford, CT 06103 (US).

(81) Designated States: JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: HEAT SEAL INFUSION WEB MATERIAL AND METHOD OF MANUFACTURE

(57) Abstract

A heat seal infusion packing material for such articles as tea bags and the like includes multicomponent thermoplastic fibers as a significant portion of the heat seal fibers. The multicomponent heat seal fibers provide improved seal strength and infusion characteristics over a broad operational window while reducing the heat seal fiber concentration within the sheet material.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Heat Seal Infusion Web Material and Method of Manufacture

Field of the Invention

The present invention relates generally to infusion web materials and more particularly is concerned with a new and improved heat sealable fibrous web having particular application as an infusion packaging material, such as for tea bags and the like.

Background of the Invention

Heretofore, heat sealable tea bag papers have comprised both single phase and multi-phase sheet material. Both materials have included non-heat seal fibers such as long natural and synthetic cellulosic fibers in combination with wood pulps and heat seal fibers. The particular heat seal fibers used included thermoplastic fibers, such as the fibers of a copolymer of polyvinyl acetate, commonly referred to as "vinyon", polyolefin fibers, such as polyethylene and polypropylene, polyolefin pulps and combinations thereof. The heat sealable papers preferably are produced using a wetlaid papermaking process and form a highly porous and open structural arrangement which, despite the heat seal fiber's hydrophobic character, permits adequate liquid permeability and transmission of both hot water and tea liquor through the sheet materials during the normal brewing process. During manufacture the sheet material is dried by a conventional heat treatment resulting in a slight contraction of the heat seal thermoplastic materials that beneficially maintains and enhances the desired open distribution of the heat seal particles throughout the sealing phase of the web.

Two general types of thermoplastic heat sealable materials have been used heretofore in heat seal infusion web production. The first contains the polyolefin pulps, vinyon fibers, or blends of these materials which typically deliver products with a wide or broad sealing temperature range, or operational window, due to difference in the melting point of

polymers used in the formulations. A range of about 130 - 240° C is typical. Unfortunately, when these products have a moderate to low heat seal fiber concentration they do not provide a strong wet seal bond in boiling water, which is critical for tea brewing. When a high level of thermoplastic is used in the web material, such as more than 50 percent by weight, the seal strength increases, but degradation is noted in the infusion characteristics of the bag.

A second generation of teabag paper is produced with polypropylene fiber in the sealing phase. This product typically delivers high seal strength and good infusion; however, due to the higher melting point of the polypropylene fibers, it seals at higher temperatures and significantly narrows the operational window of the teabag forming equipment to about 190 - 240° C. As a result, the tea packing machines must be adjusted to more precisely monitor the temperature and pressure applied by the sealing elements in order to properly seal the bags. Also, when a teapacking machine does not have very good temperature control and the temperature profile on the sealing elements is not precise, the teapacker is likely to have quality problems with the sealed teabags such that the bags tend to leak in both the dry and wet stages.

A combination of polypropylene and polyethylene fibers have been tried in the sheet material in an effort to increase the melting range of the infusion web material and therefore increase the sealing temperature range (operational window) on the packing machine. However, it has been found that such blends of polyethylene and polypropylene fibers do not deliver the desired result. The strength of both the wet and dry seals of the paper produced using such blends is weaker than 100% polypropylene fiber.

Fibrillar materials formed from polyolefins and similar polymers, commonly referred to as "synthetic pulps", exhibit certain processing advantages over the smooth rod-like synthetic fibers. The synthetic pulps exhibit a fibrilliform morphology and a resultant higher specific surface area. Additionally, they are more readily dispersible in water without the need for

additional surface active agents and, although hydrophobic in nature, they do not dewater as rapidly as conventional synthetic fibers and therefore avoid plugging problems in lines, pumps, etc. within the paper-making equipment. Further, these synthetic particles do not exhibit the tendency to "float out" in chests and holding tanks used in the typical wet paper-making process. For these reasons the synthetic pulps exhibit a potential for use as the heat seal component of infusion package materials, particularly since they provide substantially improved wet seal strength under end use conditions, that is, improved wet seal strength in a hot aqueous liquid environment and improved resistance to seal delamination under boiling and steaming test conditions.

Despite the apparent advantages evident in the use of synthetic pulp for heat seal infusion web application, it has been found that such material exhibits a significant disadvantage with respect to its infusion properties and wettability. This disadvantage relates directly to its usefulness in the paper-making process, that it, its fibrilliform structure and high specific surface area. When the synthetic pulp is heat treated, as in the conventional drying operation, it tends to soften and flow, typically forming a film, albeit discontinuous, particularly in the heat seal phase of a multi-phase sheet material. Unlike the highly porous and open web structure formed by the larger and smoother synthetic fibers, the high surface area pulp with its lower density, smaller particle size and more numerous particles results in a closed, low permeability structure. The result is that certain areas of the web surface are rendered water impermeable, substantially retarding or inhibiting infusion and reducing the water permeability and wettability of the material. In use, the non-wetted or partially wetted areas of the web material are easily observed as opaque areas on the sheet while the thoroughly wetted areas exhibit a transparent appearance. The reduced wettability of the web material coupled with its mottled opaque appearance influences the aesthetic attractiveness of the

product under end use conditions and, therefore, its acceptability by the consumer.

Summary of the Invention

Accordingly, the present invention provides a new and improved heat seal fibrous web material exhibiting improved seal strength and good infusion while maintaining a broad operational window. The invention permits the utilization of some synthetic pulp in the heat seal fibrous component yet at the same time obviates the infusion and wettability deficiencies noted hereinbefore with respect to the use of such material. More specifically, there is provided a heat sealable fibrous web having a first phase comprising natural fibers and a second or heat seal phase containing a multicomponent fiber composition or blend with natural fibers resulting in these improved characteristics.

Additionally, the present invention provides a new and improved process for the manufacture of heat seal infusion web materials having excellent infusion characteristics and improved strength characteristics through the utilization of multicomponent thermoplastic fibers in the heat seal phase. This process involves the modification of essentially only the heat seal phase of a multiphase heat seal infusion web material or, more specifically, only the heat seal component of the web material to facilitate improved infusion characteristics. This is accomplished by modifying the heat seal phase to incorporate therein the multicomponent fibers, thereby improving the wet and dry seal strength while maintaining a broad operational window and achieving high infusion rates at high, moderate and low heat seal fiber concentrations.

Other features and advantages will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the features of construction, combination of elements and arrangement of parts, as well as the several steps of the process together with the relation of one or more of such steps with respect

to each of the others and the article processing the features, properties and relation of elements of the invention will be obtained from the following detailed description that sets forth illustrative embodiments and is indicative of the way in which the principles of the invention are employed.

Preferred Embodiment of the Invention

As mentioned hereinbefore, the present invention provides a technique for improving the sealing characteristics of heat seal fibrous web materials suited for use in tea bags or the like while maintaining good infusion qualities and a wide operational range. This is accomplished by incorporating multicomponent thermoplastic heat seal fibers in the web material and particularly in the heat seal phase of a multiphase infusion web material. In the preferred embodiment, the enhancement is achieved primarily by using bicomponent thermoplastic fibers preferably with a sheath and core construction wherein each component possesses different characteristics, such as different glass transition temperatures, melting and fusing ranges and/or different melt flow characteristics. However, tri-component and even quad-component fibers may be employed. Preferably, the core of the bicomponent fiber exhibits a higher melting point than the sheath.

As mentioned, the invention is primarily concerned with multi-phase sheet material, particularly multi-phase water laid material produced in accordance with conventional paper-making techniques. In this connection, numerous different techniques have been employed heretofore to make the multi-phase fibrous webs. Typical of those found most useful in the production of infusion web materials is the dual headbox technique described in Osborne's U.S. Patent No. 2,414,833, the contents of which are incorporated herein by reference. Dry lay processes also may be employed.

In accordance with the Osborne process, an aqueous suspension of non-heat seal fibers flows through a primary headbox and an inclined wire

screen whereby the fibers are continuously deposited as a base phase on the web-forming screen. The heat seal material is introduced into the primary headbox at a location immediately after or at the point of deposition of the non-heat seal fibers on the inclined wire. This may be carried out by means of an inclined trough or a secondary headbox in such a manner that the heat seal particles comingle slightly with the non-heat seal papermaking fibers flowing through the primary headbox. In this way, the non-thermoplastic fibers have a chance to provide a base mat or non-heat seal phase prior to the deposition of the top heat seal phase thereon. It will be understood, of course, that this can be reversed whereby the heat seal fibers are incorporated into the primary headbox with non-heat seal in the secondary headbox. As is appreciated, the heat seal phase is secured to the base phase by an interface formed by the intermingling of the particles within the aqueous suspensions. Typically, sheets produced in this manner have non-heat seal fibers covering the entire surface area of the sheet materials on the surface in contact with the inclined fiber collecting screen while the top of the sheet material has some non-heat seal fibers and some heat seal fibers, with the latter predominating. In this way there is no clear line of demarcation between the two phases of the multi-phase sheet material; yet there is a predominance of heat seal thermoplastic material on the top surface or top phase of the multi-phase sheet. The central or interface boundary, or course, is composed of a mixture of the two different types of fibers.

Although the technique or process described in the aforementioned U.S. Patent No. 2,414,833 is preferably followed, the heat seal material used in preparing the heat seal phase of the sheet material is different. To this end, it is advantageous to use multicomponent and preferably bicomponent or tricomponent fibers in forming the heat seal phase of the fibrous nonwoven web. Such thermoplastic fibers come in a wide variety of configurations including, but not limited to, side-by-side and sheath-core fiber configurations as well as trilobal, cross, tipped, and segmented

structures. Suitable polymers for such multi-component fibers include, but are not limited to, polyesters such as polyethylene terephthalate and polyolefins such as polyethylene and polypropylene.

As indicated above, the multicomponent fibers of the wetlaid nonwoven web preferably have a sheath-core configuration whereby the sheath member has a lower melting point than that of the core member. Typically the sheath and core members are made of different thermoplastic synthetic material although it is possible for the sheath member and the core member to be made of the same synthetic polymer such as polyesters so long as the polymer which forms the sheath member has a lower melting point than the polymer which forms the core member. Typical bicomponent fibers comprise a polyolefin sheath, for example, polyethylene surrounding a polypropylene or polyester core. The polyethylene sheath has a melting point low enough so that the bicomponent fibers can be bonded to one another by passing the nonwoven web through the dryer section of a papermaking machine. Other effective combinations include a sheath member made of polypropylene or of polyester with the same or different core materials.

The thermoplastic synthetic fibers which can be utilized for the sheath and core members of the present invention include those fibers which will melt or soften at a temperature below about 300° C. Typical thermoplastic synthetic fibers included in the present invention include those fibers which will melt of soften at a temperature within the range of about 110 - 240° C. Typical thermoplastic synthetic fibers include polyolefins containing 1 to 8 carbon atoms, e.g., polyethylene, polypropylene, polybutylene and copolymers thereof, polytetrafluoroethylene, polyesters, e.g., polyethylene terephthalate, polyvinyl acetate, polyvinyl chloride acetate, polyvinyl butyral, acrylic resins, e.g., polyacrylate, polymethylacrylate and polymethylmethacrylate, polyamides, namely nylon, polyvinyl chloride, polyvinylidene chloride, polyvinylidene fluoride, polystyrene, polyvinyl alcohol, polyurethanes, cellulosic resins, namely

cellulose nitrate, cellulose acetate, cellulose acetate butyrate, ethyl cellulose, etc., copolymers of any of the above materials, e.g., ethylene-vinyl acetate copolymers, ethylene-acrylic acid copolymers, styrene-butadiene block copolymers, and the like.

The multicomponent fibers should be of a size that permits their use in a wetlaid papermaking process. Thus, lower denier per filament materials, for example, less than 20 dpf and as low as about 1.0 dpf, should be employed. The operable range is about 1.0 - 15.0 dpf while the preferred material falls into the range of 1.5 - 6.0 dpf and most preferably 1.5 - 3 dpf.

The fiber lengths employed also must be suited to the wetlaid process and therefore are generally less than 25 mm and preferably less than 20 mm in length. A typical operable range is about 4 - 10 mm while the preferred length is 5 - 6 mm.

The bicomponent heat seal material may be present in the web in amounts up to about 45% by weight, preferably about 5 to 40% by weight. A preferred fiber mix contains about 15 - 35% by weight of the bicomponent fibers with the remainder comprised of natural fibers. The use of the wood pulp reduces the overall cost of the final product without materially affecting the physical properties thereof. Optimally, the concentration of bicomponent fibers is about 25% by weight, but lesser amounts are employed when combined with other heat seal fibers or pulp such as polyethylene pulp.

Bicomponent fibers retain their fibrous character even when the low-melting component is at or near its melting temperature, as the high-melting component provides a supporting structure to retain the low-melting component in the general area in which it was applied. The high-melting component provides the bicomponent fibers with additional strength resulting in more open webs than those containing unicomponent fibers.

Any type of thermoplastic multicomponent fibers can be used in the manufacture of the nonwoven fabrics of this invention. For example,

sheath-core, side-by-side, and other types of bicomponent or tricomponent fibers can be used. Also, a variety of thermoplastic resin combinations is available.

Currently preferred fibers according to the present invention are the composites wherein the bicomponent fibers in the web layers are selected from the group consisting of sheath/core fibers of the following resin combinations: polyethylene/polypropylene, polyethylene/polyester, polyethylene/polyethylene, polypropylene/polypropylene, polypropylene/polyester, and polyester/polyester. Specific examples of such fibers are the 2.0 denier polyethylene/polypropylene sheath/core fibers available from Fibervisions Inc. as Product Type 426. It is provided at a length of 4 - 6 mm and denier of 1.8 - 2.2 dpf and has a sheath/core bicomponent configuration. Other 1.5 - 3 denier polyethylene/polypropylene sheath/core fibers are available from various suppliers.

While it is not desired to limit the invention to any particular theory, it is believed that the improvements of the present invention are attained because heat applied to the multicomponent fiber web causes the lower melting component to become progressively softer as the temperature increases. The lower melting materials plasticize and, as long as the temperature does not exceed the plasticizing point of the higher melting fibers, the intermolecular bond of the lower melting fibers causes bonding to occur to the other fibers. Complete high strength sealing is subsequently achieved in the tea packing machines under localized pressure and temperature.

In view of the characteristics of synthetic pulp materials, including their high specific surface area, water insensitivity, low density and smaller particle size, substantially improved seal strength characteristics under end use conditions can be achieved. These synthetic pulps are typically synthetic thermoplastic materials, such as polyolefins, having a structure more closely resembling wood pulp than synthetic fibers. That is, they contain a micro-fibrillar structure comprised of micro-fibrils exhibiting a high

surface area as contrasted with the smooth, rod-like fibers. The synthetic thermoplastic pulp-like material can be dispersed to achieve excellent random distribution throughout the aqueous dispersing media in a paper-making operation and, consequently, can achieve excellent random distribution within the resultant sheet product. The pulps found particularly advantageous in the manufacture of infusion sheet materials are those made of the high density polyolefins of high molecular weight and low melt index.

The fibrils can be formed under high shear conditions in an apparatus such as a disc refiner or can be formed directly from their monomeric materials. Patents of interest with respect to the formation of fibrils are the following: U.S. Patent Nos. 3,997,648, 4,007,247 and 4,010,229. As a result of these processes, the resultant dispersions are comprised of fiber-like particles having a typical size and shape comparable to the size and shape of natural cellulosic fibers and are commonly referred to as "synthetic pulp". The particles exhibit an irregular surface configuration, have a surface area in excess of one square meter per gram, and may have surface areas of even 100 square meters per gram. The fiber-like particles exhibit a morphology or structure that comprises fibrils which in turn are made up of micro-fibrils, all mechanically inter-entangled in random bundles generally having a width in the range of 1 to 20 microns. In general, the pulp-like fibers of polyolefins such as polyethylene, polypropylene, and mixtures thereof have a fiber length well suited to the paper-making technique, e.g., in the range of 0.4 to 2.5 millimeters with an overall average length of about 1 to 1.5 millimeters.

Typically, the fiber composition of the heat seal phase is such that it contains cellulosic paper-making fibers in addition to the heat seal fibers. In this connection, it has been found that for optimum results it is preferred that the heat seal component constitute approximately 40 to 75% of the fiber composition within the heat seal fiber phase and about 25% by weight of the infusion web. As will be appreciated, variations in the amount of heat

seal material will depend on the specific material utilized as well as the source of that material. For example, the multicomponent fiber concentration may be near the low end of the range, e.g., about 45% of the heat seal phase, when synthetic pulp is also employed. In such a formulation the multicomponent fiber constitutes only about 14 - 18% by weight of the infusion web. Of course, a sufficient amount of heat seal component must be employed to provide satisfactory heat sealability in the end product.

It should be noted that the preferred heat seal polymers are those which have already received approval for use in food and beverage applications. Consequently, the multicomponent fibers and synthetic pulp made from polyolefins and vinyon are the preferred materials while other materials may be used for different end use applications. As will be appreciated, the remaining fibers may be of a wide variety depending upon the end use of the fibrous web material. However, for infusion packages having application in the food and beverage field, it is preferable to employ approved natural or man-made fibers and preferably cellulosic natural fibers, for example, fibers of bleached or unbleached kraft, manila hemp, abaca, jute, sisal and other wood fibers. A variety of infuser web materials may be made from these fibers and utilized in accordance with the present invention. However, for ease of understanding and clarity of description, the invention is being described in its application to porous infusion web materials for use in the manufacture of teabags and the like.

The infusion characteristics of importance relative to heat seal web material relate to the rate at which water can pass into the teabag and tea liquor can pass out of the teabag as well as the degree of extraction which is able to take place within a specified time. This is usually reported in terms of "first color" and "percent transmittance", respectively. When testing for first color, a teabag made from the material to be tested is carefully placed in quiet distilled water after the water has been brought to a boil. Using a stopwatch, the time is recorded at which the first amber

stream appears at the bottom of the sample. A first color time of less than 12 seconds is required with less than 10 seconds being preferred. A first color of about 5 - 6 seconds is considered indicative of excellent infusion characteristics. Of course, thicker, heavier weight, 25 - 30 gsm and preferably 25 - 26 gsm, materials typically will have higher first color values than lighter materials of less than 25 gsm, preferably 12 - 22 gsm and most preferably 14 - 18 gsm.

The percent transmittance test is conducted by measuring the transmittance of the brew after a 60 second steep time using a Markson Colorimeter Model T-600 at a wavelength of 530 mμ and using a 1 cm cell. A target value for good infusion is in the mid-sixty percentile range with transmittance decreasing as infusion improves.

The test procedure used for determining wet delamination strength of the heat seal bond measures the time it takes for the seal to fail when subject to a standard static weight. A standard sample size of the heat sealable web material is formed into a loop with the two heat seal sides contacting each other. Heat and pressure are applied to form a seal therebetweeen. A dumbbell weight of a known value, e.g., 60 g or 100 g, is placed in the loop to apply equal force along the entire length of the seal, and the complete sample including the weight is suspended in hot water kept at a temperature of 100° C. The time in seconds from immersion until the seal fails allowing the weight to fall is recorded. The reported value is the value of repeatability based on two replicate tests, each from ten samples wherein all samples give test results within the range of 45 - 155 seconds.

The test procedure to quantify the dry seal strength measures the maximum force required to separate the dry sealed area. A strip of test material is folded in half with the heat seal sides contacting each other. The seal is formed under heat and pressure. The folded sample is cut remote of the seal and the unsealed ends are clamped in the jaws of an

Instron tensile tester. The maximum force required to effect seal failure is recorded.

The following examples are given in order that the effectiveness of the present invention may be more fully understood. These examples are set forth for the purpose of illustration only and are not intended in any way to limit the practice of the invention. All parts are given by weight.

EXAMPLE I

This example shows the improved infusion and wet seal strength characteristics obtained by using bicomponent fibers according to the present invention.

A base phase fiber dispersion was prepared from hemp fibers and wood fibers and a separate heat seal fiber dispersion was prepared using a fiber formulation comprising polyethylene synthetic pulp, polyethylene/ polypropylene sheath/core bicomponent fibers of 2 dpf and 5 - 6 mm length and kraft wood pulp. Using these dispersions, a two phase heat seal sheet material was formed on a papermaking machine to provide a web material having a basis weight of about 16.5 grams per square meter. That material is designated Sample A.

For comparison purposes, commercial web material was produced in the identical manner as Sample B using vinyon and synthetic pulp as the heat seal material. The web material was tested for infusion characteristics and wet seal strength and the results are reported in Table I. The first color and percent transmittance data is the average of four separate tests conducted in the manner set forth hereinbefore.

Table I

	A	B
Softwood	37.1	33.8
Hemp	38.7	42.0
Bicomponent fiber	16.9	--

	A	B
Synthetic pulp	7.3	12.6
Vinyon	--	11.6
Delamination (g/25mm)		
Dry MD	200	180
Dry CD	147	125
Wet delamination @ 100 g (sec)	600+	105
Infusion		
First Color (sec)	6.1	6.1
Transmittance (%)	65.6	65.0

EXAMPLE II

This example compares the wet seal strength of infusion webs having different heat seal materials at different heat sealing temperatures.

The procedure of Example I was followed except that the heat seal material only was changed. The wet delamination strength was tested using a 100 g weight. An acceptable target level is 300 seconds or greater. The results are set forth in Table II.

As can be seen, the bicomponent heat seal fibers with or without polyethylene synthetic pulp resulted in improved wet delamination strength.

When a bicomponent fiber was evaluated with the same total seal weight as previous formulation and the same PP/PE ratio, the seal strength of the paper was significantly increased and temperature range for sealability was increased from 190 - 240° C (in 100% PP heat seal paper) to 160 - 240° C (in bicomponent heat seal paper). Bicomponent fiber containing paper also delivered good infusion characteristics.

The same results were obtained when bicomponent fibers/PE pulp blends were compared to PP fibers/PE fibers/PE pulp blends. Product with bicomponent fiber delivered higher strength at lower temperatures.

Table II

Sample	Heat Seal Fibers	Wet Seal Strength					
Heat sealing Temperature (°C)		145	160	175	190	210	240
A	Polyethylene fibers	0	13	86	188	211	437
B	Polypropylene fibers	0	0	0	600+	600+	600+
C	50% A / 50% B	0	2	16	49	318	600+
D	Polyethylene pulp plus C	0	20	29	69	160	240
E	Polyethylene/polypropylene sheath bicomponent	0	490	600+	600+	600+	600+
F	Polyethylene pulp plus E	0	327	534	600+	600+	600+

EXAMPLE III

The procedure of Example I was repeated except that rayon fiber was added. The infusion web material produced had a basis weight of about 26 gsm and no synthetic pulp was used. The results are set forth in Table III.

Table III

	A	B	C
Softwood	18.3	18.3	17.4
Hemp	48.8	48.8	58.9
Rayon	9.0	9.0	--
Bicomponent	23.9	23.9	23.7
Infusion			
First Color	8.5	8.1	8.4
Transmittance (%)	69.7	70.4	68.3

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teaching of the present invention.

We claim:

1. Heat seal infusion sheet material for tea bags and the like comprising a fibrous non-woven web having improved seal strength while maintaining acceptable infusion characteristics and a broad operational window, said web comprising a combination of natural fibers and less than 50 percent by weight of heat seal fibers, at least a portion of said heat seal fibers being multicomponent thermoplastic materials with each component thereof exhibiting different melt characteristics.

2. The sheet material of claim 1, wherein said operational window falls within the range of about 110 - 240°C.

3. The sheet material of claim 1, wherein the multicomponent materials are selected from the group consisting of bicomponent and tricomponent materials.

4. The sheet material of claim 3, wherein said multicomponent materials are bicomponent heat seal fibers having a central core and an outer sheath.

5. The sheet material of claim 4, wherein the softening temperature of said central core is higher than the softening temperature of said outer sheath.

6. The sheet material of claim 3, wherein said multicomponent materials are bicomponent heat seal fibers having a side-by-side component configuration.

7. The sheet material of claim 3, wherein said multicomponent heat seal fibers are comprised of materials selected from the group consisting of polyolefins of 1 - 8 carbon atoms and polyesters.

8. The sheet material of claim 3 , wherein the materials are bicomponent and are selected from the group consisting of polyethylene/polypropylene, polyethylene/polyester, polyethylene/polyethylene, polypropylene/polypropylene, polypropylene/polyester and copolyester/polyester.

9. The sheet material of claim 1, wherein said multicomponent heat seal fibers comprise about 5 - 40% by weight of the sheet material and at least about 40 percent by weight of the heat seal fibers.

10. The sheet material of claim 9, wherein said multicomponent heat seal fibers comprise about 15 - 35% by weight of the sheet material.

11. The sheet material of claim 1, wherein the nonwoven web includes a heat seal phase and a non heat seal phase with substantially all of the heat seal fibers being located in and adjacent the heat seal phase.

12. The sheet material of claim 11, wherein said heat seal phase includes synthetic pulp and said multicomponent fiber comprises about 14 - 18% by weight of said sheet material.

13. The sheet material of claim 1, wherein said multicomponent fibers have a denier per filament size in the range of about 1.0 - 20.0 dpf and a length of less than 25mm.

14. The sheet material of claim 13, wherein said denier per filament range is 1.5 - 6.0 dpf.

15. The sheet material of claim 1, wherein said infusion characteristics include a first color infusion time of less than 12 seconds and a percent transmittance of 60 percent.

16. The sheet material of claim 1, having a wet delamination seal strength of greater than 300 seconds at 100°C using a static weight of 100g.

17. A method of forming a heat seal infusion sheet material with improved seal strength and infusion characteristics, said sheet material having a multi-phase non-woven fibrous web structure, the method comprising the steps of:

(a) forming a first phase of said non-woven fibrous web by depositing a first dispersion of fiber on a fiber collecting wire, wherein said first dispersion comprises fibers selected from at least one of:

(i) non-heat sealable fibers; or

(ii) heat sealable thermoplastic fibers, wherein at least a portion of said fibers are multicomponent fibers;

(b) subsequently forming a second phase of said non-woven fibrous web by depositing a second dispersion of fiber over the first phase to thereby form a multi-phase non-woven fibrous web structure, wherein said second dispersion of fibers comprises fibers selected from the other of (a)(i) or (a)(ii); and

(c) dewatering and drying the deposited fibers to thereby form a heat seal infusion sheet material.

18. The method as claimed in claim 17, wherein the structure of said multicomponent fibers are bicomponent.

19. The method as claimed in claim 18, wherein said bicomponent fibers have a central core and an outer sheath.

20. The method of claim 17, wherein said multicomponent heat seal fibers are water dispersible.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/22967

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :D21H 13/00
US CL :442/345, 347, 350, 351, 362, 364, 416

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 442/345, 347, 350, 351, 362, 364, 416

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y -- A	US 4,830,904 A (GESSNER et al.) 16 May 1989, see Abstract; column 3 and the Example.	1-10, 15-16 --- 11, 13-14 --- 12, 17-20
Y	US 4,289,580 A (ELSTON et al.) 15 September 1981, see entire document.	1-20
Y	US 5,173,154 A (HEINRICH) 22 December 1992, see entire document.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 05 FEBRUARY 1999	Date of mailing of the international search report 17 FEB 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer TERREL MORRIS Telephone No. (703) 308-0661

Form PCT/ISA/210 (second sheet)(July 1992)★

DERWENT-ACC-NO: 1999-313391

DERWENT-WEEK: 200204

TITLE: Heat-sealable fibrous web type infusion-packaging material

INVENTOR: BYALIK, L; VIAZMENSKY, H

PATENT-ASSIGNEE: DEXTER CORP[DEXC]

PRIORITY-DATA: 1997US-064142P (October 31, 1997)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
WO 9923306 A1	May 14, 1999	E	019	D21H 013/00
JP 2001522004 W	November 13, 2001	N/A	021	D21H 013/14
EP 1027499 A1	August 16, 2000	E	000	D21H 013/00

DESIGNATED-STATES: JP US AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE AT BE DE ES FR GB SE

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
WO 9923306A1	N/A	1998WO-US22967	October 29, 1998
JP2001522004W	N/A	1998WO-US22967	October 29, 1998
JP2001522004W	N/A	2000JP-0519152	October 29, 1998
JP2001522004W	Based on	WO 9923306	N/A
EP 1027499A1	N/A	1998EP-0957414	October 29, 1998
EP 1027499A1	N/A	1998WO-US22967	October 29, 1998
EP 1027499A1	Based on	WO 9923306	N/A

INT-CL (IPC): D21H013/00, D21H013/14

ABSTRACTED-PUB-NO: WO 9923306A

BASIC-ABSTRACT:

NOVELTY - Heat seal phase of multiphase heat-sealable infusion web material is modified to incorporate multi-component fibers, to improve seal strength while maintaining acceptable infusion characteristics and a broad operational window.

DETAILED DESCRIPTION - Heat sealable infusion sheet material consists of fibrous non-woven web comprising combination of natural fibers and below 50 wt.% heat-sealable fibers, the latter containing at least a portion of multi-component thermoplastic materials, with each component having different melt characteristics.

An INDEPENDENT CLAIM is also included for a method of

forming of heat sealable infusion sheet material with multi-phase non-woven fibrous web structure, by a) forming first phase by depositing first fiber dispersion A on fiber collecting wire, where A consists of at least one of i) non-heat sealable fibers; or ii) heat-sealable thermoplastic fibers, the latter including at least a portion of (preferably water-dispersible) multi-component fibers, having preferably bicomponent structure, especially with central core and outer sheath; b) forming second phase of non-woven fibrous web by depositing second dispersion of fibers B over the first phase, to form multi-phase non-woven fibrous web structure, with B comprising fibers selected from either (i) or (ii); and c) dewatering and drying deposited fibers to form heat-sealable infusion sheet material.

USE - In production of tea bags etc.

ADVANTAGE - Material has improved heat seal strength (wet delamination seal strength above 300 seconds at 100 deg. C, using static weight 100g) and good infusion (first color infusion time below 12 seconds and transmittance 60%) while maintaining broad operational window (110-240 deg. C).

TITLE-TERMS: HEAT SEAL FIBRE WEB TYPE INFUSION PACKAGE MATERIAL

DERWENT-CLASS: A17 A23 A92 A97 F09

CPI-CODES: A12-P01; A12-W06B; F05-A06C;

ENHANCED-POLYMER-INDEXING: Polymer Index [1.1] 018 ; G0033*R G0022 D01 D02 D51 D53 ; H0000 ; H0011*R ; S9999 S1105*R S1070 ; S9999 S1183 S1161 S1070 ; P1150

Polymer Index [1.2] 018 ; R00326 G0044 G0033 G0022 D01 D02 D12 D10 D51 D53 D58 D82 ; R00964 G0044 G0033 G0022 D01 D02 D12 D10 D51 D53 D58 D83 ; S9999 S1105*R S1070 ; S9999 S1183 S1161 S1070 ; H0000 ; P1150 ; P1161 ; P1343

Polymer Index [1.3] 018 ; S9999 S1105*R S1070 ; S9999 S1183 S1161 S1070 ; P0839*R F41 D01 D63 ; H0011*R

Polymer Index [1.4] 018 ; ND01 ; Q9999 Q8366*R ; B9999 B5312 B5298 B5276 ; N9999 N6020 N6008 ; N9999 N6780*R N6655 ; N9999 N7318 N6655 ; B9999 B5629 B5572 ; B9999 B4875 B4853 B4740 ; Q9999 Q7589*R ; K9416

SECONDARY-ACC-NO:

CPI Secondary Accession Numbers: C1999-092663